Contents lists available at ScienceDirect IF: 0.926

Asian Pacific Journal of Tropical Medicine

journal homepage:www.elsevier.com/locate/apjtm

Document heading doi: 10.1016/S1995-7645(14)60302-3

Prevalence of smear positive pulmonary tuberculosis in Gondar prisoners, North West Ethiopia

Zelalem Addis[1*], Emebet Adem[2], Abebe Alemu[1], Wubet Birhan[1], Biniam Mathewos[1], Belaynesh Tachebele[3], Yegnasew Takele[2]

[1] *School of Biomedical and Laboratory Science, College of Medicine and Health Science, University of Gondar, Gondar, Ethiopia*

[2] *Leishmania Research and Treatment Center, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia*

[3] *University of Gondar Hospital Service Laboratory, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia*

ARTICLE INFO

Article history:
Received 20 November 2014
Received in revised form 10 December 2014
Accepted 20 January 2015
Available online February 2015

Keywords:
Tuberculosis
Smear positive pulmonary tuberculosis
Prisoners
Gondar
Ethiopia

ABSTRACT

Objective: To assess the prevalence and risk factors of smear positive pulmonary tuberculosis among Gondar town prisoners, North West Ethiopia. **Methods:** A cross sectional study was conducted from February to July, 2008 in Gondar Prison. Prisoners with cough duration of more than two weeks were involved in the study by giving three sputum samples and filling the questionnaires prepared for risk factor assessment. Acid fast staining technique was employed to detect the presence of the *Mycobacterium tuberculosis bacilli* in the sputum samples. Data was analyzed using SPSS version13 computer software and presented in table. *Chi*-square test was used to assess associations and a P-value less than 0.05 was taken as significant. **Results:** A total of 384 prisoners, 349 male and 35 females, with a mean age of 33.3 years were involved in the study. The prevalence of smear positive pulmonary tuberculosis among those prisoners with cough duration of more than two weeks was 8.59%. Only the length of imprisonment had a significant association (χ^2= 18.82, *P*-value<0.0001) with the prevalence of tuberculosis. **Conclusions:** This study indicated that tuberculosis among prisoners with cough duration of more than two weeks in Gondar prison is very high. Therefore Periodic screening of the prisoners and screening of newly introduced prisoners should be practiced so as to minimize the burden of tuberculosis in prisoners.

1. Introduction

Tuberculosis (TB) is the leading cause of death from infectious diseases that affects mainly adults. Around two third of TB cases are estimated to occur among people aged 15-59[1]. In 2010, there were an estimated 8.8 million incident cases of TB (range, 8.5 million-9.2 million) globally, equivalent to 128 cases per 100 000 population. Most of the estimated number of cases in 2010 occurred in Asia (59%) and Africa (26%). Asia and Africa account for 55% and 32% of cases globally, respectively. The sub-Saharan African countries have the highest rates, with an average rate of about 300 per 100 000 populations. Of the 8.8 million incident cases in 2010, 1.0 million-1.2 million (12%-14%) were among people living with human immunodeficiency virus (HIV), with a best estimate of 1.1 million (13%). The proportion of TB cases co-infected with HIV is highest in countries in the African Region; overall, the African Region accounted for 82% of TB cases among people living with HIV[1, 2].

Ethiopia ranked 7th among the high burden countries and 9th among the multi drug resistance tuberculosis priority countries in 2010[1]. It is one of the top three in Africa,

*Corresponding author: Zelalem Addis, University of Gondar, P.O.Box 196.
Tel: +251-912-060902
Fax 251-8-11-14-79
E-mail :addiszelalem151@gmail.com or zelalemaddis@ymail.com

with regard to a number of TB patients. According to the federal ministry of health hospital statistics data, pulmonary tuberculosis was the third leading cause of hospital admission (7.8%), and the first leading cause of in-patient deaths (10.1%) in 2001[3].

Prisoners are often housed in overcrowded facilities with inadequate ventilation, hygiene and sanitation. Food that is provided can be unappealing and nutritionally inadequate. Health services may be weak or absent. Illegal behavior such as the use of alcohol, drugs or sexual activities (without consent) may continue unchecked. Such conditions are ripe for the outbreak of epidemic diseases, including TB and HIV. Hence, prisons have often been cited as possible reservoirs of TB[4].

The scourge of TB in prisons remains a persistent problem; rates among inmates remain much higher from 5 to up to 50 times than those of national averages across both the developed and the developing world[5].

Prisoners do not represent a cross section of society; a high proportion is poorly educated and socioeconomically disadvantaged. They therefore bring with them into prison an increased risk of ill health, including a high risk of tuberculosis infection and disease. Prison life is not conducive to good health. Overcrowding and prolonged exposure through long prison sentences (even for seemingly minor offences) promote tuberculosis. Illegal drug use, although forbidden, is common, and injecting equipment is used in primitive and unhygienic conditions. Sex between men, voluntary or forced, occurs, and use of condoms is rare. The HIV epidemic further complicates control of tuberculosis in prisons. Prison conditions, tuberculosis, and HIV transmission are thus interconnected[6,7]. Only few studies have reported on the prevalence of tuberculosis among prisoners in Africa from Nigeria, Cameroon, Malawi, Zambia and Ethiopia[7-12]. The aim of this study was to assess the prevalence of smear positive pulmonary tuberculosis in Gondar town prisons, North West Ethiopia.

2. Materials and methods

2.1. Study design

This cross sectional study was conducted from February to July 2008 in Gondar prison, North West Ethiopia. Gondar is one of the Zonal cities in Amhara regional state located 746 km away from Addis Ababa, the capital of Ethiopia. The Gondar prison locally called "Bata prison" was built in 1930 and still facilities were not well organized and cells were not well ventilated. During the study period there were about 1 624 prisoners in two blocks, one for males and one for females. On average the number of individuals per cell was around 200 during the study period. In the prison there is a clinic that follows the health status of the prisoners and refers cases like tuberculosis to Gondar University Hospital for confirmation and initiation of treatment. Once cases are confirmed and treatment is initiated it is the responsibility of the clinic to follow the improvements.

2.2. Sampling technique

A total of 384 prisoners were actively selected to participate in the study. First all prisoners were collectively questioned for the presence of cough then those prisoners with cough were individually interviewed about the duration of cough. Prisoners who had cough history of more than two weeks were included in the study.

2.3. Data collection and analysis

2.3.1. Sociodemographic data and risk factor assessment

A structured questionnaire was used to collect necessary information from the prisoners. The questionnaire included age, sex, previous living area before imprisonment, educational level, history of contact with tuberculosis patient and duration of cough.

2.3.2. Sputum collection

Study participants gave three sputum samples, spot-morning-spot, for acid fast staining. Sputum samples were collected in clean, dry tightly caped containers. Mucopurulent and purulent samples were only used for investigation of acid fast bacilli. The samples were immediately taken to Gondar University Laboratory for analysis.

2.3.3. Acid fast staining and microscopic examination

The staining process was done as described by Cheesbrough, 2006[13]. To assure the quality of microscopy at regular intervals, and always when a new batch of stain is started, two sputum smears of known high and low AFB positivity were stained with the routine smears to check that the carbol fuchsin, staining method, and the microscopical examination of smears were satisfactory[13]. The smears were observed by two laboratory technicians. and dDiscordant results were firmed by an experienced laboratory technologist and the result given by this individual was taken as a final result.

2.4. Data analysis

The collected data was entered and analyzed using SPSS version 13 computer soft ware and mean and percentages were used to summarize the results. Results were presented in tables. The *Chi*-square test was utilized to assess significant differences in the prevalence of tuberculosis among prisoners based on the sociodemographic variables. A difference was taken as significant at a *P*-value less than 0.05.

2.5. Ethical consideration

The study was ethically cleared and approved by the ethical review committee of department of Medical laboratory technology, University of Gondar. Study participants who were able to read and write gave informed consent to participate in the study while those who were illiterate gave informed consent. Prisoners who were found positive for acid fast bacilli were treated based on the directly observed short course treatment guideline.

3. Result

3.1. Sociodemographic characteristics of the participants

In this cross sectional study 349 male and 35 female, a total of 384, prisoners were involved. The mean age of the prisoners was of 33.3 years and most of them (42.4%) being in the age range from 18-27 years. 88.8% of the prisoners stayed in the prison for a maximum of five years. More than half (60.41%) of the prisoners were imprisoned from rural areas and Christianity was the religion of majority (87.5%) of the prisoners. Around 48.8% of the prisoners were illiterate while 27.08% had attended primary school. Majority (80.9%) of the prisoners had history of contact with tuberculosis patients before imprisonment and drinking unboiled milk from unscreened cow was also the history of about 54.4% of the prisoners (Table 1).

3.2. Results of sputum microscopy

The prevalence of smear positive tuberculosis among the total prisoners was 2.03% (33/1624) and the prevalence

Table 1
Sociodemographic variables and their association with the prevalence of tuberculosis in Gondar prison.

Variables		AFB result			χ^2 (*P*-value)
		Positive (%)	Negative (%)	Total (%)	
Age	18-27	12 (3.12)	151 (39.32)	163 (42.44)	3.422 (0.490)
	28-37	11 (2.86)	72 (18.75)	83 (21.61)	
	38-47	6 (1.56)	66 (17.18)	72 (18.75)	
	48-57	3 (0.78)	37 (9.63)	40 (10.41)	
	>58	1 (0.26)	25 (6.51)	26 (6.77)	
Religion	Christians	29 (7.55)	307 (79.94)	336 (87.5)	0.005 (0.950)
	Muslims	4 (1.04)	44 (11.45)	48 (12.5)	
Sex	Male	30 (7.81)	319 (83.07)	349 (90.88)	0.000 (0.996)
	Female	3 (0.78)	32 (8.33)	35 (9.11)	
Residence	Urban	15 (3.9)	137 (35.67)	152 (39.58)	0.520 (0.470)
	Rural	18 (4.68)	214 (55.72)	232 (60.41)	
Stay in prison	⩽5 years	22 (5.72)	319 (83.07)	341 (88.8)	18.820 (0.000)
	6-9 years	2 (0.52)	9 (2.34)	11 (2.86)	
	⩾10 years	9 (2.34)	23 (5.98)	32 (8.33)	
Educational level	Illiterate	16 (4.16)	170 (44.27)	186 (48.43)	
	Read and write	5 (1.3)	53 (13.8)	58 (15.1)	0.003 (0.999)
	Primary school	9 (2.34)	95 (24.73)	104 (27.08)	
	Secondary school	3 (0.78)	33 (8.59)	36 (9.375)	
Previous contact with Tb patient	Yes	21 (5.46)	190 (49.47)	211 (54.94)	1.100 (0.295)
	No	12 (3.12)	161 (41.92)	173 (45.05)	

among those with cough duration of more than two weeks was 8.59% (33/384). From those who gave sputum samples, 5.73% (22/384) and 2.86% (11/384) were positive from three sputum samples and from two samples respectively. Among the positives 7.8% (30/384) were males and 0.78% (3/384) were females with no significance association between sex and tuberculosis prevalence. The positivity rate within the sex group was 8.59% and 8.57% in males and females respectively. Relatively high positivity rates, 36.36% (12/33), 54.54% (18/33) and 48.48% (16/33) were observed in the age group of 18-27, in those who lived in rural areas before imprisonment and among illiterate prisoners respectively. Among those prisoners whose sputum samples were positive for acid fast bacilli 63.63% (21/33) had history previous contact with tuberculosis patient before their imprisonment. Among the total positives 66.66% (22/33) the prisoners stayed in the prison for a maximum of 5 years (Table 1).

3.3. Risk factor assessment

Almost all, except one, the risk factors assessed did not show a statistically significant association with the prevalence of tuberculosis among prisoners. The period of imprisonment was the only risk factor that showed a significant association with the prevalence of tuberculosis among prisoners. With a *Chi*-square value of 18.82 and a *P*-value of less than 0.000 1 period of imprisonment had a significant association with smear positive pulmonary tuberculosis among prisoners.

4. Discussion

The result of the current study indicated that tuberculosis Gondar prison is very high with a prevalence of 2.03% among the total prisoners and 8.59% among prisoners with cough duration of more than two weeks. These high rates are expected to be attributable to, in large part, the high concentration of risk factors for tuberculosis in incoming prisoners, including HIV infection, a history of intravenous drug use, low socioeconomic status, malnutrition, homelessness, and inability to access community-based health care. Additional risk factors, such as poor ventilation and overcrowding, promote transmission of tuberculosis in prisons[14].

The result of this study is much higher than the results reported from Malawi from 18 prisons[9] which reported a prevalence of 0.7%. The difference may be attributed to the methods employed in the selection of study participants; the Malawian study recruited prisoners with cough history of one week and above which may cause decreased case detection and increased sample size, but our studies includes only individuals with cough greater than two weeks. A study from Brazil also showed a low prevalence (4.5%) as compared to our study which may still be attributed to the selection criteria of patients because the Brazilian study included only prisoners with cough duration of greater than three weeks which made the sample size very small that results low prevalence[15].

On the contrary, our study showed a lower prevalence as compared to a study from Zambia which reported a prevalence of 15.6% among prisoners who gave sputum samples[10]. This difference may be explained by the difference in criteria used for selection of study participants and the type of diagnostic tool employed. In addition to culture the fluorescence microscopy was used in the Zambian study, which all will increase the possibility of case detection and hence the increase the prevalence. A relatively closer report was found from Cameroon (10.6%) [8]. Similarly a study from prisons of Eastern Ethiopia by, Abebe *et al* 2011, indicated a similar prevalence (8.9%) to our study[11]. In addition a recent report from our study area has also reported a relatively closer prevalence (10.4%)[12].

In Sub Saharan Africa, the average TB incidence and prevalence rates are 363/100 000 and 475/100 000 respectively. Tuberculosis in prisons encompasses not only TB in prisoners, but tuberculosis in prison staff that ultimately interact directly with their families and community when they leave work[16]. In Ethiopia the incidence and prevalence rates were estimated 353/100 000 and 533/100 000 respectively in 2004[17]. In line with this high incidence and prevalence the result we found is an alarming one which requires an urgent action since the prevalence may be higher than this.

The current result revealed that year of imprisonment has a significant association (χ^2= 18.82, P<0.000 1) with prevalence of tuberculosis those who were imprisoned for a maximum of 5 years being the more affected. This may be possible because new cases of tuberculosis positive prisoners are being introduced to the prison. This situation on the other hand may contribute to the increased prevalence of tuberculosis in the general population as those prisoners released may transmit the infection.

The results of this study indicate the importance of initial screening of newly introduced prisoners to the prisons. More over periodic screening is also important to minimize the burden of tuberculosis.

Despite the importance of this study in indicating the

status of tuberculosis in the prison of Gondar, it has also limitations. If the sample size used was increased and additional diagnostic tools like chest X-ray and culture were used the prevalence may be higher than what we have already reported, but due to financial and logistic issues these were not possible. Moreover with the ever increasing TB-HIV co-infection it could have been important if the situation was investigated in the current study. Over all with these limitations this study has demonstrated that tuberculosis is still a major problem to the prison population.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

The authors thank the university of Gondar hospital laboratory for material and reagent support, Gondar prison authorities for collaboration during our data collection, and finally the prisoners who were willing to participate in this study.

References

[1] WHO. *Global tuberculosis control.* 2011. Report No.: WHO/HTM/TB/2011.16.

[2] Anonymous. TB-HIV co-infection.[Online] Available from: http://www.action.org/resources/item/tb-hiv-co-infection [Accessed on March, 2013].

[3] Federal Democratic Republic of Ethiopia Ministry of Health. *Tuberculosis, TB/HIV and leprosy prevention and control strategic plan 2007-2009/10.* Addis Ababa, Ethiopia: Disease Prevention and Control Department; 2007.

[4] Dara M, Grzemska M, Kimerling EM, Reyes H, Zagorskiy A. *Guidelines for control of tuberculosis in prisons. USAID, 2009.* [Online] Available from: http://pdf.usaid.gov/pdf_docs/PNADP462.pdf

[5] The PLoS Medicine editors. The health crisis of tuberculosis in prisons extends beyond the prison walls. *PLoS Med* 2010; **7**: 1-2.

[6] WHO Regional Office for Europe. Status paper on prisons and tuberculosis. WHO, 2007. [Online] Available from: http://www.euro.who.int/__data/assets/pdf_file/0004/69511/E89906.pdf

[7] Lawal MA, Omili M, Bello TO, Onuha L, Haruna A. Tuberculosis in a Nigerian medium security prison. *BJPM* 2009; **11**: 1-8.

[8] Noeske J, Kuaban C, Amougou G, Piubello A, Pouillot R. Pulmonary tuberculosis in the Central Prison of Douala, Cameroon. *East Afr Med J* 2006; **83**: 25-30.

[9] Banda HT, Gausi F, Harries AD, Salaniponi FM. Prevalence of smear-positive pulmonary tuberculosis among prisoners in Malawi: a national survey. *Int J Tuberc Lung Dis* 2009; **13**: 1557-1559.

[10] Habeenzu C, Mitarai S, Lubasi D, Mudenda V, Kantenga T, Mwansa J, et al. Tuberculosis and multidrug resistance in Zambian prisons, 2000-2001. *Int J Tuberc Lung Dis* 2007; **11**: 1216-1220.

[11] Abebe DS, Bjune G, Ameni G, Biffa D, Abebe F. Prevalence of pulmonary tuberculosis and associated risk factors in Eastern Ethiopian prisons. *Int J Tuberc Lung Dis* 2011; **15**: 668-673.

[12] Moges B, Amare B, Asfaw F, Tesfaye W, Tiruneh M, Belyhun Y, et al. Prevalence of smear positive pulmonary tuberculosis among prisoners in North Gondar Zone Prison, northwest Ethiopia. *BMC Infectious Dis* 2012; **12**: 352-358.

[13] Cheesbrough M. Microscopical techniques used in microbiology. In: *District laboratory practice in tropical countries part 2.* Cambridge University Press UK, Cambridge; 2006.

[14] Fazel S, Baillargeon J. The health of prisoners. [Online] Available from: www.thelancet.com [Accessed on]November 19, 2010. DOI:10.1016/S0140-6736(10)61053-7.

[15] Vieira AA, Ribeiro AS, Siqueira MA, Galesi MNV, Santos ARL, Golub EJ. Prevalence of patients with respiratory symptoms through active case finding and diagnosis of pulmonary tuberculosis among prisoners and related predictors in a jail in the city of Carapicuíba, Brazil. *Rev Bras Epidemiol* 2010; **13**: 641-650.

[16] O'Grady J, Hoelscher M, Atun R, Bates M, Mwaba P, Kapata N, et al. Tuberculosis in prisons in sub-Saharan Africa e the need for improved health services, surveillance and control. Tuberculosis 2011: 1-6. [Online] Available from: http://intl.elsevierhealth.com/journals/tube

[17] Montoro E, Rodriguez R. Global burden of tuberculosis. In: Palomino JC, Leão SC, Ritacco V, editors. Tuberculosis 2007: From basic science to patient care. [Online] Available from: www.TuberculosisTextbook.com